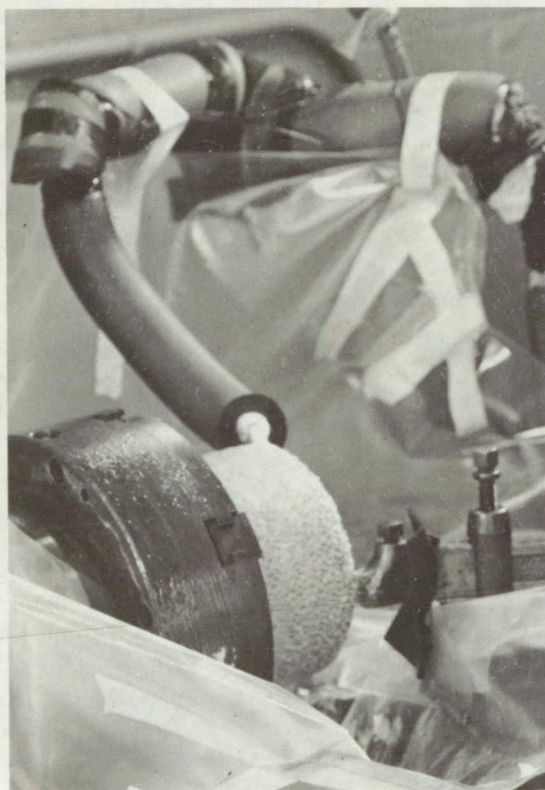


AEC-NASA TECH BRIEF



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Cold Machining of High Density Tungsten and Other Materials



The problem:

To devise more effective methods for machining refractory and reactive metals and their alloys. Previously prescribed machining procedures often produced only fair results and in some instances complete failures. No pertinent machining information was available for the new materials.

The solution:

A "sub-zero" or "cold machining" process, using a sub-zero refrigerated cutting fluid, which gives favorable results in the machining of refractory and reactive metals. Cutting performance is further improved by the use of special carbide tools for turning and drilling these alloys.

(continued overleaf)

How it's done:

When coolants at sub-zero temperatures are applied during machining operations, the process is called "cold machining." Various coolant compounds were investigated; the most effective was a solution of 25 % by volume of trichloroethylene in Stoddard Solvent. A pint of alcohol is added to the coolant to absorb water and eliminate freezing in the tubing connections. A mechanical refrigeration system is used, with which temperatures as low as -140°F can be obtained and controlled to plus or minus a few degrees.

A lathe with maximum rigidity and precision spindle bearings performs the turning, boring, drilling and threading operations. All bearing surfaces of the machine are protected from the coolants whose degreasing action would remove the necessary lubricants. Polyethylene sheeting, ~ 0.005 in. thick, which can easily be taped to the machine and is relatively inexpensive, is used for this protection. A hole is pierced in the plastic sheeting between the ways of the lathe to act as a drain for the coolant. A stainless steel reservoir, equipped with an 8-in. high baffle, catches the coolant and serves as a chip trap to avoid damage to the coolant pump. From the reservoir, the coolant is pumped back to the refrigerator. All coolant plumbing to and from the refrigerator is insulated to avoid frosting and rising temperature.

Tungsten carbide tooling, the general purpose C-2 grade such as 883 carboloy, is employed. Brazed insert tools are preferred over the throw-away type for they are easier to sharpen and easier to modify to a given geometry. The tooling must be sharp. Diamond wheels of 180 mesh diamond or finer give the best sharpening results.

Before the start of machining, the coolant is allowed to flow over the workpiece and tool long enough to obtain a predetermined temperature. This coolant flow is continued throughout the machining operation.

Drilling is accomplished with solid carbide drills that have been pointed on a precision drill pointer equipped with diamond wheels of 180 mesh diamond or finer.

The successes and failures in machining tungsten have been directly related to the process used to produce the bar stock. It must be of a uniform grain structure, free of local segregation of carbides and other hard particles. The optimum temperature for machining high density tungsten is -40°F for both the workpiece and the cutting tool.

Tool life varies from two minutes for the arc cast and swaged tungsten, to eight minutes for the pressed, sintered, and swaged tungsten.

The following metals and alloys have proved the easiest to machine using the sub-zero coolant: TZM; Nicrotung; thoriated tungsten; TV-10; TV-20; Mo70-30W; tantalum; molybdenum; pressed, sintered and swaged tungsten 99+%; arc cast and swaged tungsten 99+%; and Inconel X-750. Neoprene and rubber have also been machined to tolerances of 0.001 inch or less using special procedures.

Notes:

1. This information may be of interest to jet engine manufacturers and other industries which produce machined shapes from tungsten.
2. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B69-10110

Source: P. Ziegelmeier
Central Shops
(ARG-10289)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U. S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439